FUTURE PERSPECTIVES

- Advancements in Tongue Analysis Technologies

- Standardization

- Tongue Analysis formal education and training

- Use of tongue in forensic practice.

Technologies have been on the advancing front and with there has been evolution in the analysis of tongue also. This has made changes giving more accurate and reliable results in medical and biometric applications. Some known advances are:

1.   Artificial Intelligence (AI) and Machine Learning: Recently the use of Artificial intelligence using algorithms and machine learning has gained a lot of popularity in tongue analysis which has made automated feature extraction and the recognition of patterns possible. AI encompassed systems can really help humans in identifying the unique tongue characteristics which are required in diagnosing medical conditions and help in forensic and biometric identification.

2.   Increased resolution of imaging: Intraoral cameras and Optical Coherence Tomography (OCT) give very good quality images in terms of resolution especially of the dorsal surface of the tongue. If the image is of good quality, it positively enhances the visualization and interpretation of the images giving more accurate analysis after tongue examination.

3.   Computer vision techniques: We are quite aware that any form of study is prone to subjective differences and human prejudices to overcome these factors Computer vision techniques can be used. They can automatically use tongue images for analysis. These can be used for detection of abnormalities and analysing other features of the tongue.

4.   Phone applications for Tongue analysis: Tongue is such a promising diagnostic and biometric tool that smartphone applications are being developed to help medical diagnosis and for individual use. Patients can just take the picture of their tongue with the smartphone and get information regarding

5.   Advances in imaging techniques: traditionally images which were 2 – Dimensional were used for study and diagnosis but recent advances have made 3- Dimensional imaging possible. This gives better examination

opportunities making variations in structure and abnormalities in surface details more apparent to diagnosis.

6. Tongue as an adjunct: Greater accuracy can be attained by the use of tongue analysis in collaboration with other forensic tools. This can be explained by stating that finger print scanning can be used with tongue scans. This can give very reliable results. Better identification systems can be made on this model.

7. Other modes like Data Analytics can be used for tongue diagnosis.

8. Health tracking with wearable trackers especially for the tongue can be worked on. As literature proves the tongue be very helpful in overall health diagnosis.

9. Misuse of Data and unauthorised access should be taken care of. Privacy is paramount.

10. With technological advancement comes security and privacy issues which need to dealt with in order to use data efficiently.

STANDARDISATION IN TONGUE ANALYSIS:
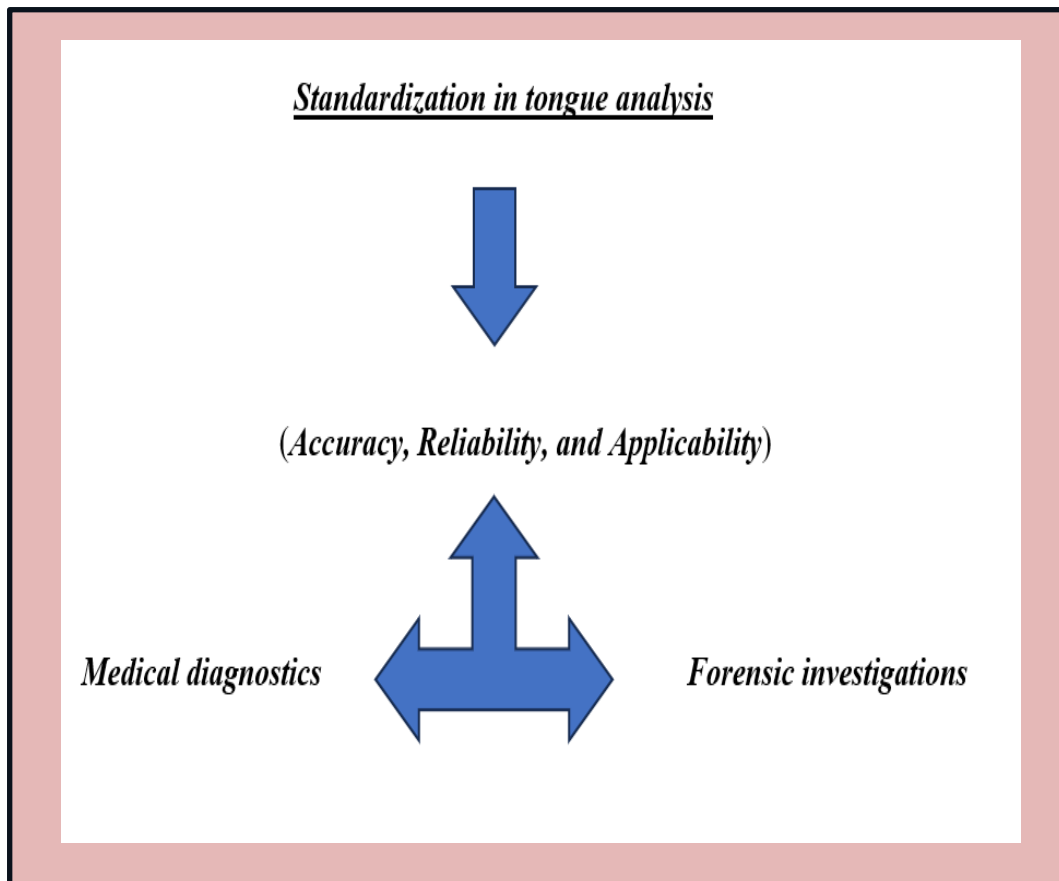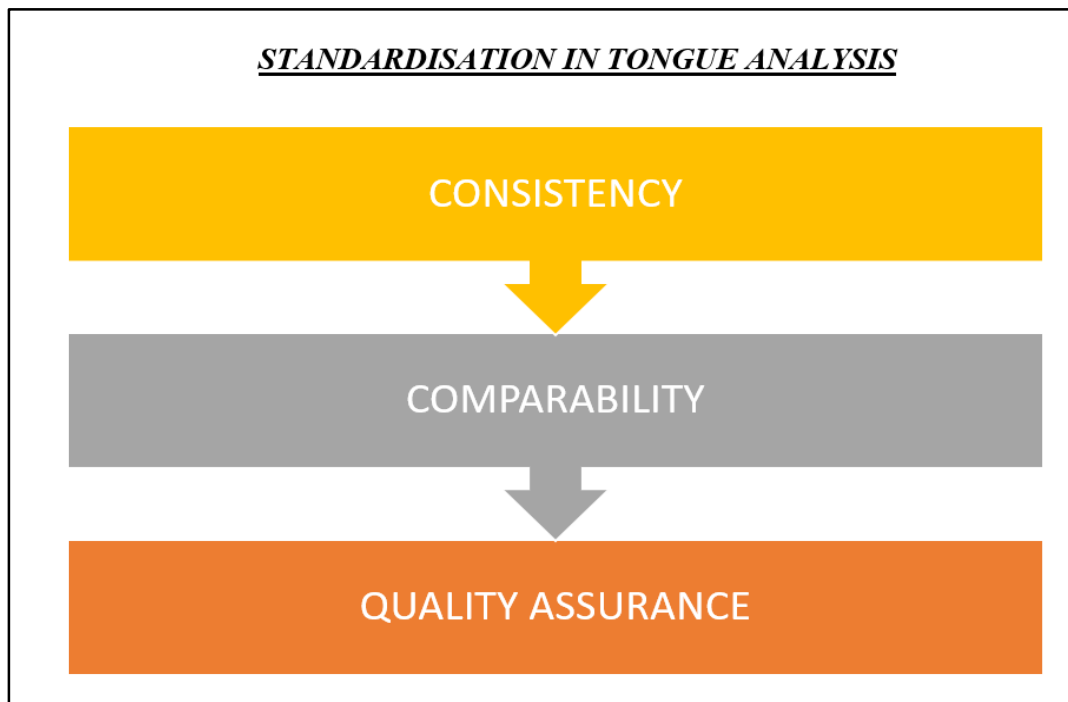
TONGUE ANALYSIS FORMAL EDUCATION AND TRAINING:

- **CURRICULUM FORMULATION : TEACHING**

  Structured Education Anatomy And Physiology , Tongue, Normal Variations,

  Pathological Changes and Specific Tongue

- **EDUCATIONAL & ACADEMIC COURSES**

  TAKEN IN :Medical Schools, Dental Schools, Traditional Medicine Programs

- **CONTINUOUS EDUCATION PROGRAMS : FOR PROFESSIONALS ALREADY PRACTICING**

- **HANDS-ON TRAINING WORKSHOPS FOR VALIDATION**

- **CERTIFICATION PROGRAMS FOR TONGUE ANALYSIS**

- **INTERDISCIPLINARY TRAINING INITIATIVES**

- **ONLINE EDUCATIONAL RESOURCES: FOR TONGUE TRAINING**

- **COLLABORATING WITH UNIVERSITIES, RESEARCH INSTITUTIONS**

- **PRACTICAL CASE STUDIES**

- **ETHICAL AND LEGAL : EXPLANATIONS AND INFORMATION ON GUIDELINES.**

In order to use the technology well we need a workforce which is skilled enough, with experience to carry out the procedures. This is only possible if there are enough

training formally acquired to carry out the process. To make this possible it is very important to pay attention to the areas responsible for the education and training.

USE OF TONGUE IN FORENSIC PRACTICE

Proof of identity in Humans	Since tongue has unique characteristics, it can used for identification
In association with Bite Mark	Tongue prints in conjunction with bite marks can be used in forensic identification for more reliable results.
Identification in dead bodies	During postmortem when body is disfigured, tongue comes to rescue.
Forensic investigations	Tongue due to its stability and reliability acts an excellent tool for forensic investigation
Estimation of Time Since Death	Tongue changes in colour after death can help us calculate the postmortem interval
Guilty or not Guilty in criminal cases	This can be done with the help of tongue prints.

Khan et al. 2023 stated that even though tongue due to its distinctive properties is one of the primary tools in TCM diagnosis not much has been done with the tongue in relation to disaster. Its role in manmade disaster and natural disasters should be evaluated.

They also spoke about the future scopes related to tongue prints and documented that Methods like spectrum analysis and Gabor filter are being to analyse tongue prints. These are producing noteworthy outcomes. They state that only after the tongue prints have undergone pre- processing for form analysis and texture, they can be used for tongue print biometric verification. This requires expensive tools and specialised knowledge. If these constrains are removed in future tongue prints can really help humans.[9]